Radionavigation Bulletin

Spring/Summer 2001 Issue Number 36

Spotlight on Navigation Center Operations

In this issue we would like to spotlight some of the people and equipment that the Navigation Center uses in its overall responsibility for supervision and management of all DGPS and LORAN operations.

The Navigation Center has two divisions which oversee all aspects of radionavigation operations - an East Coast division and a West Coast division. The Eastern Operations Division is responsible for operations in the Eastern and Southeast United States, Gulf Coast, Great Lakes, and Canadian East Coast. The West Coast Operations Division is responsible for operations in the Western United States, Alaska, and Canadian West Coast. Each Division has a fully equipped and staffed operations center for 24-7 oversight response to casualties. The East Coast Operations Center is located at the Navigation Center's primary facility in Alexandria, VA**,** while the West Coast's is located at Navigation Center Detachment Petaluma, CA.

Navigation Center, Alexandria, Virginia

The Eastern and Western Operations Division Officers report directly to the Commanding Officer of the Navigation Center. They are charged with overseeing day-to-day operations, monitoring and documenting system performance, coordinating maintenance and repair evolutions, and supplying real-time status information to the users of the navigation and timing signals provided by the Coast Guard radionavigation program.

Reporting to the Division Officers are highly knowledgeable and experienced officers in the fields of LORAN and DGPS. In the field of LORAN, these officers are entitled Chain Operation Control Officers, or COCOs, and in DGPS, the officers are simply called the DGPS Operations Officers. The COCOs are responsible for the close day-to-day supervision of their respective LORAN-C chains, and they have broad authority over the functional operations performed by all elements of their chains, including the LORAN stations. In DGPS, the responsibilities are much the same, except of course, their responsibility is over individual DGPS sites, rather than "***chains***". Both the LORAN and DGPS branches of the East and West Coast, among other duties, review and evaluate the performance of stations and sites, gather and analyze data to ensure proper performance of equipment, and provide technical and/or logistical support for the repair and/or *maintenance* of stations and sites as necessary.

To properly carry out their duties, the COCOs and the DGPS Operations Officers need the assistance of trained personnel to provide them with information from which to make decisions. To do this, the Navigation Center staffs both its East and West Coast Operations Centers with Petty Officers trained in the field of electronics. After undergoing a rigorous technical qualification program, the Petty Officers stand watches to continuously monitor the signals and parameters of the LORAN stations and DGPS sites.

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Inside this bulletin:

From the Commanding Officer…

Some progressive and exciting developments are now underway…a few of these improvements and efficiencies will impact the quality of service we provide our customers while some will help position NAVCEN to take on additional roles. We hope these new roles will further the Coast Guard's stewardship of safe navigation as the 21st Century brings "eNavigation" into the Maritime Transportation arena as a mainstay.

RNAV Improvements

As modernization of the Loran system moves out, the Coast Guard will leverage the new technology that Loran Support Unit is so ably installing, or will install in the system over the coming few years. Remote control of our LORSTAs will become a reality in a manner similar to the way we presently control and monitor our DGPS sites throughout the country. As a test of this capability, we've been operating LORSTA Jupiter Inlet remotely since April 2000. Starting this summer, we will be automating two more LORSTAs, and working through some very contentious support and maintenance issues with representatives from MLCA, LSU, and other effected entities. The result will be a down sizing of the resources needed to support and operate Loran, resources which can be returned or reprogrammed to other areas of the Coast Guard, while maintaining or improving our availability statistics.

Meanwhile, new functions and capabilities for Loran are being explored, A successful test of Loran as a data channel without disrupting the Loran pulse has been accomplished with a throughput of 250 bps (the size of the Federal Aviation Administration's (FAA's) Wide Area Augmentation System (WAAS) signal). This summer, an on-air test at LORSTA Tok will determine operationally if a receiver in an aircraft can see the entire WAAS message, which will allow planes to get the WAAS corrections for GPS, and therefore enhance aviation in the Alaska portion of the National Air Space.

Within the DGPS system, more stations are becoming operational throughout the center of the country, while new stations that are adjacent to older maritime sites allow us to retire older and harder to maintain equipment. Work is progressing to get even greater accuracy from DGPS, from 2 meters or so down to 20 centimeters. This will have a major impact on certain technologies related to highway and railway safety.

NAVCEN Roles

A reorganization has been underway for the last two years and I'm happy to report that the proposal submitted to HQ has been approved. Highlights of this reorganization include merging the Loran Control Station at Kodiak into the Petaluma detachment, alignment within NAVCEN with our business areas since the closure of Omega, and the additional capability of assuming responsibilities for Electronic Charting. With respect to charting, the Executive Secretariat responsibilities of the newly established Electronic Charting Guidance Team reside at NAVCEN. Results have already been realized beginning with the establishment of a Data Sharing working group that will help move navigation aid data to National Oceanic and Atmospheric Administration (NOAA) and other agencies that use this information. A new Memorandum of Agreement (MOA) was just signed with NOAA that will provide for the free access to Electronic Nautical Charts (ENCs) that otherwise would have been purchased for our many cutters.

Project management for initiatives such as Automated Local Notice To Mariners (ALNM) has been moved to NAVCEN as well and we are building an expertise in handling like projects…a capability that we will need as the Coast Guard progresses into greater eNavigation development and deployment.

We will have more news in our next bulletin on our progress in these and other areas. Meanwhile, business is good….

—— CAPT Tom Rice, NAVCEN

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Contributors: Articles are welcome from all parties. Articles for publication should be sent to: Commanding Officer, USCG NAVCEN, 7323 Telegraph Road, Alexandria, VA 22315-3998. Articles may be submitted typewritten in 10 or 12 characters per inch, on an IBM-PC compatible 3.5 inch floppy disk (returned on request). The Radionavigation Bulletin staff reserves the right to edit all material submitted. Copyrighted material will not be accepted without the author's and/or publisher's written release/permission.

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New Responsibilities for the Navigation Center

The Navigation Center's (NAVCEN) web site has been "the site" for a broad spectrum of mariners to obtain information and tools to aid in navigation. One of those tools, the Local Notice to Mariners (LNM), has been a mainstay on the web site for several years. As reliance on the internet and associated technologies has advanced, *electronic distribution* of navigation information, such as the LNM, has become routine. However, the process of *creating* the LNM is a manually-intensive process, with minimal reliance on automation.

NAVCEN will be assuming responsibility for the Local Notice to Mariners Automation project. The goal is to share information from several disparate (and non-compatible) aids to navigation databases and automate the collection and dissemination of aids to navigation information (e.g., LNM). The integration of the information into the current Aid to Navigation Information System (ATONIS) will put a wealth of data into one functional database.

The integrated ATONIS database is considered by NAVCEN to be an opportunity to facilitate the Coast Guard's transition for the use of Electronic Navigational Charts (ENCs). National Oceanic and Atmospheric Administration's National Ocean Service will be able to use the Coast Guard's ATONIS database to update ENCs automatically, thus enabling them to maintain a current portfolio of electronic charts. In turn, the Coast Guard, as well as any mariner using an electronic navigation system, will benefit from this up-to-date ENC portfolio.

The Navigation Center is excited about its new role in automation and dissemination of electronic navigation information; it is a natural progression from our radionavigation roots. New initiatives in support of electronic navigation, such as an expanded use of ATONIS, are essential to achieving the Coast Guard's goal of promoting safe navigation.

—— Marie Sudik, NAVCEN

Spotlight on Navigation Center Operations

(Continued from Cover page)

They are responsible for taking immediate action to correct or improve operations and equipment failures, and for informing the COCOs and DGPS Operations Officers as necessary. These watchstanders are a critical link in the Navigation Center's operational mission, as they are the first to know of a problem with a signal which may cause a problem for the user. They are responsible for immediately notifying the user if there is a signal that may be in error or if there is no signal being transmitted at all.

Irrespective of how well-trained the Navigation Center's watchstanders are, they cannot perform their duties without the proper tools to do so. The Operations Centers on both the East and West Coast are equipped with LORAN and DGPS "***control stations***" which provide real time signal and station/site parameter information. Each control station is programmed to provide an array of alarms should any one of several parameters or signals go out of specified tolerance. The watchstanders can then take prescribed actions to correct the problems directly from the control stations, or if the problems are beyond their immediate resolution, they can call on an established support infrastructure, including notification of the COCOs or DGPS Operations Officers, to resolve the problems.

This brief description and overview of the Navigation Center's Operations Departments is only one of many facets of the Center's overall responsibility for LORAN and DGPS radionavigation in the United States. Effective operations do not occur without precise and comprehensive planning, policy decision making, dissemination of information, and close interaction with users, and other agencies and countries involved in the transmission of radio signals. Naturally, the Navigation Center is staffed to complete these missions also, and it is through the close coordination of all divisions with the Center that afford us the privilege of calling ourselves The Radionavigation Center of Excellence.

—— LCDR Mike Baca , NAVCEN

Navigation Center Detachment, Petaluma, California

Cruising Into The Future

May 11, 2001 may well be a landmark day for Government, the maritime industries, and the public alike. At 11:00 A.M. on that date, directors from the National Oceanic and Atmospheric Administration (NOAA) and the United States Coast Guard formally signed a cooperative agreement that will help NOAA develop and maintain a complete set of electronic charts covering all U.S. coastal waters sooner and at a lower cost to the Government than if NOAA had tackled the problem alone. Additionally, the agreement establishes a framework for sharing navigational information in a seamless manner. Margaret Davidson, the Acting Assistant Administrator, National Ocean Service and Rear Admiral Terry M. Cross, Assistant Commandant for Operations, signed the agreement.

Margaret Davidson and Rear Admiral Terry M. Cross

A NOAA initiative seeks to produce charts in a new format known as the Electronic Navigational Chart (ENC) or, as it is commonly referred to in the international community, S-57. ENCs are databases standardized as to content, structure and format, issued on the authority of a government-authorized hydrographic office. Until now, ENC production has been slow due to resource constraints at NOAA.

The Coast Guard also has an electronic nautical charting initiative. However, the Coast Guard initiative aims to develop an Electronic Chart Display and Information System (ECDIS) that could eliminate the need for paper charts. According to the international standard, a system must use ENCs in order to be ECDIS-compliant. In an attempt to move forward, the Coast Guard commissioned vendors to produce *near*-S-57 charts to meet its immediate charting needs. However, these near S-57 charts lacked some features required for full compliance with the S-57 standard and, most importantly, they were not *issued for use with ECDIS on the authority of government-authorized hydrographic offices.* Therefore, without NOAA-approved ENCs, the Coast Guard's ECDIS solution became an ECDIS dilemma.

In response to this quandary, officials from the Coast Guard and NOAA began meeting several months ago to discuss how Coast Guard-commissioned near-S-57 charts could be assimilated into NOAA's suite of official ENCs. One meeting milestone was a common product specification to be used by both parties when producing electronic charts to ensure compliance with the S-57 standard. Also, a harmonized production schedule is being developed to prevent any duplication of charts.

(Continued on page 14)

Electronic Charting Guidance Team

At the end of the second millennium, another link was forged in the continuing saga of electronic charting. The Assistant Commandants for Systems, Operations, and Marine Safety and Environmental Protection chartered the Electronic Charting Guidance Team (ECGT). The focus of this group is to develop a harmonized Coast Guard approach to the issues of electronic charting whether they are internal to the agency, national, or international in scope. Landmark action taken by the ECGT in its first few sessions have been:

- Development of a Memorandum of Understanding (MOU) between the Coast Guard and NOAA that covers both the purchasing and sharing of **S-57**[1] chart data. This MOU is a significant first step toward harmonizing the past, present, and future goals of NOAA and the Coast Guard to achieve S-57 chart coverage of U.S. waters while keeping the life-cycle costs—chart development and maintenance—to a minimum for the Coast Guard and NOAA.
- Creation of working groups to improve the Coast Guard's process for providing ATONIS data to NOAA and to develop and improve training for electronic chart systems that have been or will be fielded in the Coast Guard.

(Continued on page 6)

Mr. Noda of Japan Coast Guard Visits U.S. for Exchange of Views on DGPS and VTS

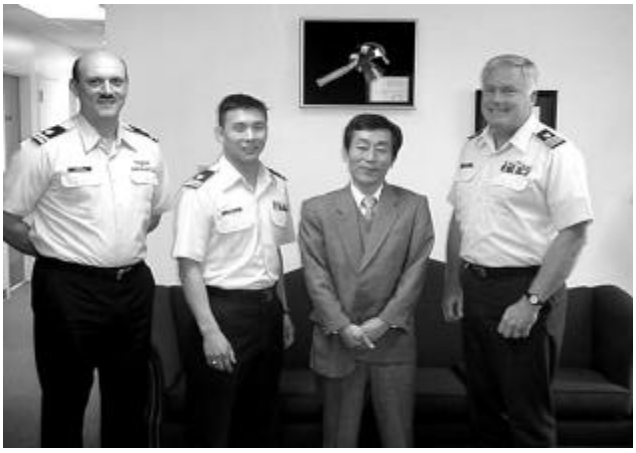
The Navigation Center (NAVCEN) was glad to host Mr. Masami Noda from the Japan Coast Guard in a professional exchange of views dealing with Differential Global Positioning System (DGPS) and Vessel Traffic Service (VTS).

Mr. Noda is the Senior Operations Officer at the DGPS Center for the Japan Coast Guard (JCG, formally JMSA). During the last few years, representatives from the JCG have visited NAVCEN annually. The purpose of these visits is to exchange information about our DGPS operations and are in keeping with the spirit of cooperation between the two countries.

Japan operates a network of 27 DGPS sites from one Control Center located in Tokyo. As Senior Operations Officer, Mr. Noda's primary interest was the operations and policy perspective of DGPS. His visit was maximized by gathering information on VTS for another JCG office. We found that the JCG and USCG are facing very similar operational and policy questions including, but not limited to, operating in an environment without GPS Selective Availability, dealing with lightning strikes, corrosion from salt spray, alarm threshold settings, and methods of data reporting and analysis. The visit included a tour of NAVCEN's Operations Center for DGPS, Loran and the Navigation Information Service.

Engineers from the command and Control Engineering Center (C2CEN) met with Mr. Noda and discussed several technical issues relating primarily to lightning protection and integrity monitor and reference station firmware and processing. Of significant value was the visit to the operational DGPS site located at Driver, VA. Mr. Noda also toured the C2CEN facility and was particularly interested in the equipment laboratories including DGPS, VTS and Shipboard Command and Control Systems for the 210', 270' and 378' cutters.

The USCG Headquarters Office of Vessel Traffic Management provided Mr. Noda a very thorough brief on the USCG Vessel Traffic Services along with a detailed information packet for him to provide to his VTS counterparts in the JCG.



LT Wood, LT Pickles, Mr. Noda and LCDR Schenk

In the afternoon, while departing Washington D.C., Mr. Noda had an unexpected bonus - a glimpse of President Bush as the President's motorcade went by.

The US Coast Guard was pleased to have Mr. Noda visit and share his knowledge with us. Personally, we enjoyed our time with Mr. Noda on both a professional and personal level.

—– LT Dan Pickles & LTjg Dean Jordan, NAVCEN

Electronic Charting Guidance Team

(Continued from page 5)

- Issue of a change to the Code of Federal Regulations (CFR) that exempts certain public vessels from the requirement to carry paper charts.

The next meeting of the ECGT will be in June 2001. Persons desiring more information on the activities of the ECGT should feel free to contact LT Daniel Mades at (703) 313-5837.

[1]**The S-57** format is the international community's official standard for electronic chart data, one of the key components to Electronic Chart and Display Information Systems . See the International Hydrographic Organization Special Publication No. 57 (IHO S-57) for further details.

—– CWO James Fitz-Gerald, CG Headquarters

Nationwide Differential Global Positioning System Status Report

The Coast Guard Nationwide DGPS (NDGPS) implementation team has added four more U.S. Air Force Ground Wave Emergency Network (GWEN) conversions to the NDGPS network. The newest four are located near New Bern, NC, Summerfield, TX, Spokane, WA, and Polson, MT; bringing the total number of operating NDGPS sites to sixteen.

The next few months will see another flurry of GWEN site conversions. These sites include Annapolis, MD, Kirtland, NM, Hagerstown, MD, and Hawk Run, PA. Later in the summer we will also convert Pueblo, CO and Bakersfield, CA. Two sites that have been planned for a while are finally expected to be built this summer: Brainerd, MN and Myton, UT. The Minnesota Department of Transportation has greatly assisted us in identifying and procuring a suitable site near Brainerd, MN.

Funding for this year was about half of the administration request. As a result single coverage expected in 2002 is now delayed until the year 2003. Future sites in Alaska are on hold pending adequate funding availability.

The Coast Guard is one of the seven-agency partnerships for the Department of Transportation's NDGPS expansion initiative to provide DGPS signals to inland users coast-to-coast. This Nationwide coverage will help to "enable technology" – allow other technology to work at a better level. Nationwide coverage will also assist various safety services such as Positive Train Control for the Federal Railroad Administration.

This summer one exciting project is expected to be complete. The Hagerstown, MD site will serve as a test bed for a concept demonstration to provide users with carrier phase observables that will provide better than 20 centimeters vertical accuracy.

We are continuing to refine the procedures necessary to build new sites and convert GWEN sites to NDGPS sites. Our trickiest procedure continues to be obtaining X.25 communications to the site. Great progress has been made in this area, but delays seem to be inevitable. Every task that is required to complete a site requires great effort from a variety of different units and organizations working together such as: Civil Engineering Units, Maintenance and Logistics Commands, Command and Control Engineering Center, Federal Highway Administration, Federal Railroad Administration, U. S. Air Force, Army Corps of Engineers, Bureau of Land Management, Tennessee Valley Authority, various state agencies, and the National Oceanic and Atmospheric Administration. In addition to all of these agencies, the project relies on a host of commercial companies such as: Allied Technology Group, Ensco, Sprint, and many local companies.

As long as funding holds out we will continue our goal of coast-to-coast coverage. The DOT Policy and Implementation Team continues to oversee implementation and decide which sites should be constructed/converted. Of course delays will always happen due to all of the standard caveats: contracting issues, communication, and other various situations.

—— LTjg Dean Jordan, NAVCEN

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Loran-C Innovations And the Automated Loran Station (PALS)

Loran Recapitalization Project Background

The LRP initiative will modernize the U.S. Loran System to meet present and future radionavigation requirements while leveraging technology and funds to optimize operations, support, and training, and reduce the total cost of ownership.

Loran "upgrade and modernization" efforts began in 1997 at the U.S. Coast Guard Loran Support Unit following the signing of a Federal Aviation Administration (FAA)/U.S. Coast Guard (USCG) Interagency Agreement. The Loran Recapitalization Project (LRP) effort will modernize the Loran-C radionavigation infrastructure in order to preserve operations well into the future. The end goal may be to reduce or completely eliminate personnel at the Loran Transmitting Stations, greatly reduce all required equipment maintenance, and eventually outsource all maintenance, operations, training, and depot repair of the entire Loran System.

What exactly does this mean? A complete replacement and/or upgrade of all electronics systems at all 29 Loran Transmitting Stations (LORSTAs), 29 Primary Chain Monitor Set (PCMS) Sites, and 4 Control Sites located throughout North America. This includes:

- Tube-Type Transmitter (TTX) replacement at up to 14 locations.
- New/re-furbished buildings at all sites receiving replacement transmitters.
- Tower replacement/modernization at selected sites.
- Complete replacement of all PCMS equipment.
- Complete replacement of all Loran Timing and Frequency Equipment (TFE).
- Installation of the Remote Automated Integrated Loran (RAIL) command & control equipment.
- Installation of new whole-station Uninterruptible Power Supply (UPS) systems.
- Complete replacement of all Loran Casualty Control receivers.
- Major upgrades and improvements to the Loran Consolidated Control System (LCCS).
- Enhancements to the capabilities of the Loran System.
- Improvements with the availability, continuity, integrity, and accuracy of the Loran System.

Where Does ALS Fit Into the LRP Effort?

Without the LRP systems upgrades mentioned above, the ALS effort would not be feasible. The key electronics upgrades required to automate a Loran Station are:

- Tube-Type Transmitter (TTX) replacement. ALS is not feasible at TTX stations.
- Installation of the Remote Automated Integrated Loran (RAIL) command & control equipment.
- Installation of new whole-station Uninterruptible Power Supply (UPS) systems.
- Upgrades to station monitoring systems: fire, intrusion, tower lights, etc.

PALS/ALS Background

In the fall 2000 issue of the *Systems Times*, the Loran Support Unit (LSU) released an article describing the concept for the *Prototype* Automated Loran Station (PALS) project. In this article, LSU highlighted the purpose, the goals, and the key areas to be addressed during the first ever unmanned field-test that was presently underway at Loran Station Jupiter. Loran Station Jupiter is shown in **Figure 1**. If you recall, Jupiter was selected as the best choice for the PALS trial because this station experiences the most severe power and lightning problems of any station. With this in mind, LSU figured if Loran station Jupiter could be PALS'ed, the technique could be extrapolated to all of the other North American Solid State Transmitter (SSX) stations.

The Coast Guard is spending approximately $27M for Loran Operation and Maintenance (O&M) costs annually. Of this amount, $9M are Standard Personnel Costs (SPC) associated with the approximately 166 billets tied to staffing the 24 U.S. Loran Stations.

Under the ALS concept, operational costs are primarily reduced by:

1. Addressing Loran electronic maintenance concerns through an existing, nearby Electronics Support Unit or Detachment (ESU/ESD) rather than having electronic technicians attached to the LORSTA, and

2. Addressing LORAN facility maintenance, including the installed generator set (GENSET), through a matrix of contracts and USCG technical personnel assigned nearby.

3. Lowering operating costs by de-manning and the removing the administrative burden associated with an OPFAC.

Figure 1: Loran Station Jupiter, FL

PALS/ALS Current Status

PALS/ALS successfully operated without a full-time on-site crew and met all operation requirements including signal availability. All preventive and corrective maintenance was successfully performed by the local ESD under their normal standard operating procedures, including the 30-minute response to recall and three-hour on-site response. The field test lasted 28 weeks, which included the severe thunder storm season and most of the annual hurricane season. Due to the overwhelming success, Loran Station Jupiter is continuing to operate in its present configuration with future plans to fully implement the automation this FY. The PALS/ALS concept is also being implemented at additional Loran Stations in the Southeast U.S. (SEUS) Loran Chain: Grangeville, LA and Carolina Beach, NC. Remote Automated Integrated Loran (RAIL) Systems have already been installed at these sites and both are scheduled to receive operations room and transmitter Uninterruptible Power Supply (UPS) systems, and remote tower lights monitoring systems this FY.

What Tools/Processes/Ideas are We Using to Make PALS/ALS a Reality?

Does the *e-Coast Guard* and Information Technology play a role in the automation of Loran Stations? You bet it does… The following tools/processes/ideas are making ALS a reality:

- Maximize Use of InTERnet/InTRAnet for Information Exchange
- Maximize Use of Commercial Off The Shelf (COTS) Equipment
- Use "Leading Edge" not "Bleeding Edge" Technology
- Keep it Simple
- Define and "Lock Down" Clear Requirements
- Design Open-Ended, Flexible, Modular, Scalable Systems
- Maximize Use of Extended Warranties
- Use IT to Automate Systems
- Maximize "Planned Iterations" to Minimize "Unplanned" Iterations
- Always Keep Your Customer(s) Involved
- Use IT as a "Tool", not a Crutch
- Break Large Projects Into Smaller, Manageable Projects

Benefits of Maximizing InTERnet/InTRAnet Usage

The Internet and Intranet, specifically the LSU websites, are key to the success of the ALS effort. The websites are expanding to include ALL information necessary for Configuration Management (CM) and support of the North American Loran-C System. With fewer people available to support and operate the Loran System, up to date supporting information and rock-solid CM is vital. The answer…centralize this information and make it available over the net. Here are just a few of the benefits:

- Loran-C "One Stop Shopping"
  - ***** System Documentation: EILSPs, Operator's Guides, Field Changes, SMEF Advisories, Diagrams/ Schematics, Installation Plans, etc.
  - ***** Configuration Management
  - ***** Training (Future Addition)

- Loran Recapitalization Project Procurements
  * Posting of Specifications has Cut Months off Procurement Lead-times
  * Maximizes "Full & Open" Competition
- Information Available to the Field and the Public in "Real Time"
- Maximizes Sharing of Information
- Facilitates "One DOT"
- Saves Time & Money!

PALS/ALS Future Plans…*The Sky's the Limit*

Phase I of the PALS project was a great success. It showed that a Loran Station with a solid state transmitter (SSX) could be operated as an unmanned transmitter site, while continuing to meet the required 99.9% availability standard. Shortly after the upgrades are completed at Loran Stations Grangeville and Carolina Beach, NAVCEN will join forces to fully automate these stations and Loran Station Jupiter. The "PALS Planning Proposal" written by NAVCEN lays the ground work for what is to come. **Figure 2** depicts one possible scenario of what ALS could accomplish.

For more information: Contact LTJG Randy Little at (609) 523-7352 or via e-mail at *rllittle@lsu.uscg.mil* or LCDR Al Arsenault at (609) 523-7349 or via email at *aarsenault@lsu.uscg.mil*. More information can be accessed via the LSU Web Page at**:** *http://www.uscg.mil/hq/lsu/webpage/lsu.htm*

—— LCDR Gary Thomas, Loran Support Unit

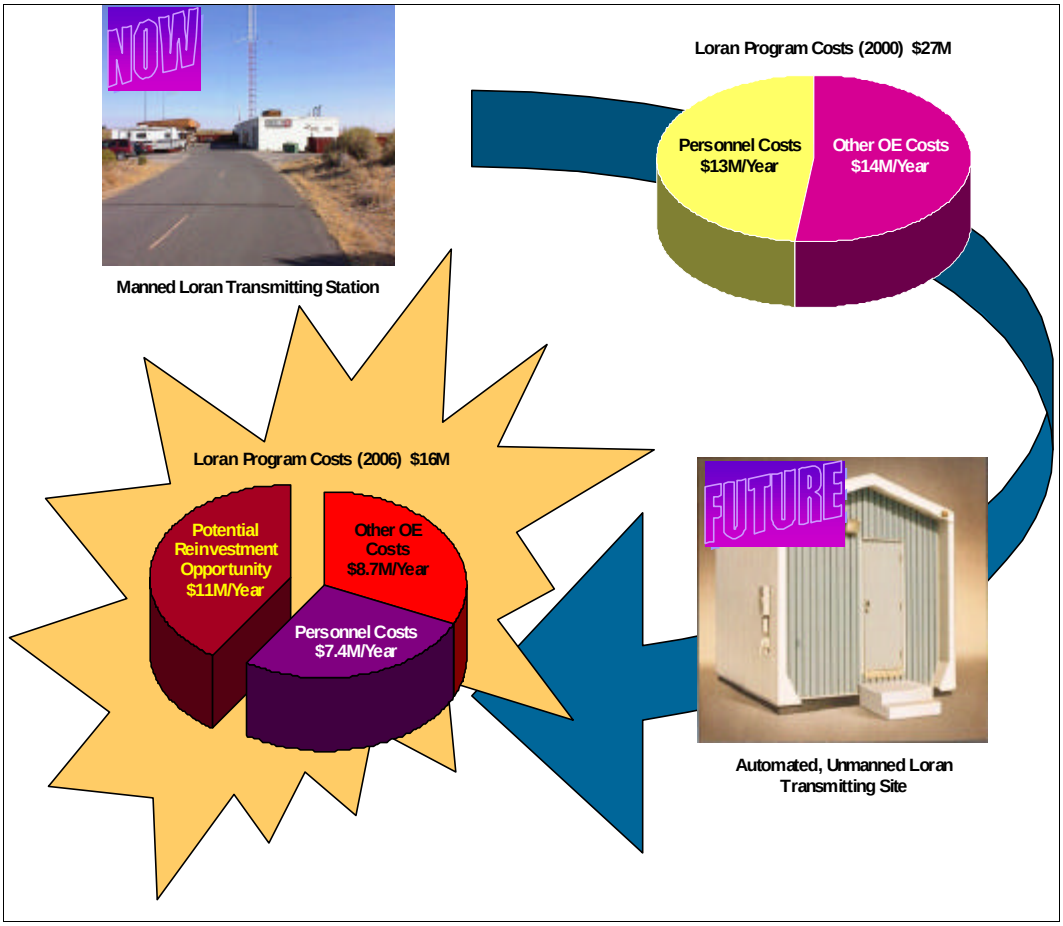

Figure 2: One Possible ALS Scenario

-Note-

The views expressed herein are those of the author and are not to be construed as official or reflecting the views of the Commandant, U.S. Coast Guard, or U.S. Department of Transportation.

Global Positioning System III

The U.S. Government is collecting suggestions for improvements to the GPS system. In doing so, the civil GPS user community is being provided a unique opportunity to input their ideas into the system architecture development of GPS III.

To better serve you and this process, please supply the requested contact information. Contact information may be important in case the reviewers have questions or would like to further discuss your ideas.

The limits to the scope of this questionnaire are the limits of your imagination. Please don't miss this opportunity to be a part of the GPS-III development.

GPS III Questionnaire

1. Contact Background Information

**Last/Family Name*_____ **First Name*_____
*Title*_____
*Organization*_____
Street address _____
_____
City _____ *State/Province*_____
*Zip/Postal code*_____ **Country*_____
Phone _____ *FAX*_____
E-mail _____

2. Category that best describes your GPS use (aviation, maritime, surveying, research, etc.)
_____
3. Category that best describes your business._____
4. *****How do you use GPS? _____
_____
5. How can GPS service be improved to support your application?
_____
_____
6. What additional/improved GPS capability would you recommend?
_____
_____

***Required**

Visit the NAVCEN website to fill out the form online (*http://www.navcen.uscg.gov)*, or Fax to USCG NAVCEN (CGSIC) at +1-703-313-5805 or E-mail: *rcasswell@navcen.uscg.mil*

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Civil Global Positioning System Service Interface Committee Meeting Policy Notes

The Civil GPS Service Interface Committee held its 37th Meeting in Arlington, Virginia from 27-29 March 2001. CAPT Thomas Rice, CO, NAVCEN, opened the meeting and welcomed the participants.

- GPS Policy: Joe Canny, Chair CGSIC, and Deputy Assistant Secretary for Navigation Systems Policy, stated that no substantial changes to GPS policy were anticipated in the new administration. The commitment to sustain the constellation and modernize GPS will proceed.

- The draft L5 Signal Specification was published by RTCA in December 2000. The first version of the ICD-705 should be published by 2003. The first draft is expected by summer 2001. The FAA is developing prototype receivers for compatibility testing.

- The IGEB is considering a proposal to replace C/A code on L2 with a more robust, modernized code. The potential benefits of the replacement code (R/C) include improved resistance of the signal to interference and expanded reception under trees and in urban canyons. There will be an option to maintain or restore the current C/A code and navigation message capability.

- The GPS III Architecture Study kick-off was in November. The twelve-month effort will define the capabilities of the GPS III architecture, including the satellites and ground segment. The entire GPS community is asked to participate, either through the contractors or through the questionnaire **(page 11)** or forum on the NAVCEN website. These satellites are expected to become operational in 2010 and will have the flexibility to reflect future technological advances.

- Preparations for World Radio Conference 2003 continue. GPS spectrum is still vulnerable to attacks and the technical work to protect it is ongoing. Ultra-wide Band (UWB) technology is the latest to threaten infringement in the band. The National Telecommunications Information Administration and Department Of Transportation sponsored testing show interference from certain UWB implementations to GPS, other safety-of-life navigation and communications systems.

- The 2001 Federal Radionavigation Plan (FRP) has begun the Clearance Process. The Secretaries of Transportation and Defense are expected to sign it in late summer. The 2001 Edition will be separated into two parts. The first will be the FRP and will retain the policy, operating plans, and R&D Sections of the previous document. The second section, the Federal Radionavigation Systems, will contain the static information, such as system descriptions, requirements, and roles and responsibilities. The documents will be available on the NAVCEN website or by CD after the document is signed.

- The next meeting of the CGSIC will be held in Salt Lake City, Utah, 9-11 September 2001 at the Sheraton City Center Hotel.

—— Rebecca Casswell, NAVCEN

CGSIC 38th

Meeting Announced

Sep. 09 - 11, 2001

Salt Lake City, Utah

Sheraton City Center Hotel

WAAS, DGPS and the Mariner's Toolkit

On August 24, 2000, the Federal Aviation Administration (FAA) announced that their space-based, L-band Wide Area Augmentation System (WAAS) became available for use by "some aviation and all non-aviation" users. The FAA announcement has prompted numerous inquiries to the Coast Guard regarding the maritime use of WAAS and the status of the Coast Guard DGPS system. The following Questions and Answers are directed at helping to clarify the status of these two systems for the mariner.

1. Why did the Government design and build two different GPS augmentation systems?

The 1994 National Telecommunications and Information Administration (NTIA) Technical Report to DOT on a National Approach to Augmented GPS Services studied the necessity of expanded government efforts in providing DGPS services. Its goal was to recommend the optimum integrated system to meet aviation and terrestrial navigation needs. A variety of systems were being proposed at the time. The study concluded that a combination of two systems, the FAA's Wide/ Local Area Augmentation Systems (WAAS/LAAS) and the USCG's DGPS system, was the optimum mix. This integrated system, consisting of the L-band line-of-sight WAAS for aviation users, and the terrain-following medium frequency DGPS for maritime and terrestrial users, meets the vast majority of the nation's precise navigation and positioning needs.

2. Is WAAS currently certified for maritime navigation?

No. WAAS is not yet fully operational and is currently in a testing status, undergoing further development. It is not certified for use as a safety of life navigation system in the maritime navigation environment. WAAS may be used, with caution, in the maritime environment to improve overall situational awareness, but it should not be relied upon for safety-critical maritime navigation. The Maritime DGPS Service, on the other hand, is fully operational and meets all the standards for the harbor entrance and approach phases of navigation

3. After WAAS reaches initial operating capability in a few years, will it be suitable for maritime navigation?

WAAS is not optimized for surface (maritime and terrestrial) use, rather, it was designed primarily for aviation use. It is intended to eventually support aeronautical enroute through precision approach air navigation. The current WAAS test signals are transmitted by two geo-stationary satellites on a line-of-sight, L-band radio frequency. This means that if anything obstructs the view of the portion of the sky where the satellite is, the WAAS signal will be blocked. Since geo-stationary satellites are positioned over the equator, the farther north users are, the lower the geo-stationary satellites are in the sky - increasing the likelihood of an obstruction. In contrast, the medium frequency (285-325 kHz) radiobeacon-based Maritime DGPS Service is optimized for surface (maritime and terrestrial) applications because it's ground wave signals "hug the earth" and wrap around objects. This means that the Coast Guard DGPS system is well suited for the marine environment (down in the "ground clutter") where a geo-stationary satellite can be blocked by terrain, harbor equipment and other man-made and natural objects.

4. Can the Coast Guard's DGPS system be used by aviation?

That's up to the FAA. However, the Coast Guard's system was designed with the surface (maritime and terrestrial) user in mind. It was neither designed nor intended to meet aviation requirements. Although aviation users could potentially get some modest benefit from the Coast Guard's DGPS for applications such as surface traffic management at airports or General Aviation, it could not attain the type and level of aeronautical service for which WAAS and LAAS are designed, without significant re-engineering.

5. Is the Coast Guard DGPS system a "transient technology" that is here today but will be gone tomorrow?

No. DGPS has already been adopted globally as an international maritime standard established by the 1994 International Telecommunications Union document ITU-R-M.823. It meets IMO Resolution A 815 (19) standards for navigation in harbor entrances and approaches. Over 40 nations have fully embraced this robust technology and are implementing DGPS services identical to our own.

6. Which system is more accurate, WAAS or DGPS?

On the average, WAAS and DGPS accuracy are virtually the same, although DGPS accuracy is better when the user is near a DGPS transmitting site. The WAAS architecture is designed to provide uniform 7m accu-

racy (95%) regardless of the location of the receiver—within the WAAS service area. DGPS is designed to provide better than 10m navigation service (95%), but typically provides better than 1 meter horizontal positioning accuracy (95%) when the user is less than 100 nautical miles from the DGPS transmitting site. Accuracy then degrades at a rate of approximately 1 meter per hundred nautical miles as the user moves away from the transmitting site. A total of 56 maritime DGPS sites provide coastal coverage of the continental United States, the Great Lakes, Puerto Rico, portions of Alaska and Hawaii, and portions of the Mississippi River Basin..

Conclusions: Once WAAS becomes fully operational, the combination of Coast Guard and FAA systems is expected to provide a robust, complementary service to all modes of transportation. We look forward to the day that industry provides the public with a fully integrated receiver, one that uses all available radionavigation systems to provide unprecedented accuracy, integrity, and availability.

Despite the differences between DGPS and WAAS, it should always be kept in mind that both services ultimately rely upon a single navigation system – GPS – which is vulnerable to interruption at any time. This lends additional credence to the recommended practice of using all available means of navigation and not relying upon any single system. Remember, prudent mariners will always keep looking out the window!

—— LT Terry Johns, CG Headquarters

Cruising Into The Future

(Continued from page 5)

While discussions continued over S-57 charts, a second effort began to improve the flow and quality of chart-related information between the agencies. At issue was the need for a uniform data transfer format, one that would simplify data download and generation of chart corrections. Moreover, it also became clear that the quality of the data needed to improve since electronic charting systems will have the capability for greater resolution and accuracy than traditional paper charts. Currently, chart corrections pass through many manual processes—from the initial recording by the Coast Guard on scene to the final capture by the NOAA cartographer—so the probability (and the occurrence) of errors is high. Presently, NOAA gets its data for chart corrections from the Coast Guard's Local Notices to Mariners. Clearly, the need to re-engineer the process, to define common formats and data structures so that critical information can be disseminated more quickly and more accurately is also an important focus of the agreement.

Essentially, the agreement focuses both agencies on a common goal—to promote safe navigation. With both agencies developing electronic charts to the same standard, this agreement goes a long way towards helping NOAA achieve its objective of having full ENC coverage of coastal waters of the U.S. and its territories. The Coast Guard benefits by having access to a suite of ENCs that fully comply with the S-57 standard—the last piece required to bridge the gap between paper and paperless charting. The maritime industry will benefit if NOAA can achieve its secondary objective to make ENCs available free of charge over the Internet. The obvious benefit to industry is that the market for electronic chart systems will expand to include smaller vessels such as fishing and passenger vessels. This expansion will benefit industry and lead to increased safety and awareness on U.S. waterways. This is the greatness and the potential of the agreement signed by the National Oceanic and Atmospheric Administration and the Coast Guard. This is the future of maritime navigation.

(seated) Margaret Davidson, Rear Admiral Terry M. Cross (standing l-r) CWO James Fitz-Gerald, LT Daniel Mades, CAPT Dan Deputy, CAPT David Glenn, CAPT Charles Lancaster, and CDR Gregory Kmiecik

—— CAPT Nick Perugini, NOAA and
CWO James Fitz-Gerald, CG Headquarters

Loran-C Recapitalization Project...an Update

LCDR Al Arsenault; Loran Recapitalization Project Manager

Continuing to make progress…the joint USCG/ Federal Aviation Administration Loran Recapitalization Project (LRP) is well underway. The LRP initiative will modernize the U.S. Loran System to meet present and future radionavigation requirements while leveraging technology and funds to optimize operations, support, and training, and reduce the total cost of ownership. What exactly does this mean? A complete replacement and/or upgrade of all electronics systems at all 29 Loran Transmitting Stations (LORSTAs), 29 Primary Chain Monitor Set (PCMS) Sites, and 4 Control Sites located throughout North America.

The following is a status update concerning major LRP initiatives:

Completed:

- Installation of the Loran Consolidated Control System (LCCS) throughout North America. **[Completed in FY99]**
- Replacement of all PCMS equipment. **[Completed in FY00]**
- Installation of the Automatic Blink System. **[Completed in FY00]**
- Installation of Command & Control wireless Backup Communications. **[Completed in FY00]**
- Frequency Standard Replacement. **[Completed in FY01]**

Underway:

- Tube-Type Transmitter (TTX) replacement at up to 14 locations (includes LSU & Loran Training School).
- Possible replacement and/or Service Life Extension of all Solid State Transmitters (SSX) at 17 locations.
- New/refurbished buildings at all sites receiving replacement transmitters.
- Tower replacement/modernization at selected sites.
- Replacement of all Loran Timing and Frequency Equipment (TFE), including integration of new cesium beam oscillators, Automatic Blink System (ABS), and Universal Time Coordinated (UTC) synchronization functionality.
- Installation of the new Remote Automated Integrated Loran (RAIL) command and control equipment.
- Installation of new Uninterruptible Power Supply (UPS) systems; one for the Operations Room equipment and one for the transmitter system.
- Replacement of all Loran Casualty Control receivers.
- Major upgrades and improvements to the Loran Consolidated Control System (LCCS).
- Enhancements to the capabilities of the Loran System.
- Improvements with the availability, continuity, integrity, and accuracy of the Loran System.

The following sections provide some LRP history and also snapshots of where the Loran-C system was prior to 1997 and where it is now.

MAJOR MODERNIZATION INITIATIVES: "BEFORE" & "AFTER"

The North American Loran-C system can be looked at as a system with three major components, each with its own suite of equipment. The first component is the Loran Station (LORSTA), which consists of the timing and transmitting equipment needed to transmit the Loran signal to the user. The second component is the Primary Chain Monitor Set (PCMS) site, which consists of monitoring equipment necessary to ensure the Loran signal seen by the user is within published tolerances. The third component is the Control Station, which consists of command and control equipment that

is operated 24x7 and remotely connects to the LORSTA equipment and PCMS equipment for a Loran chain. **Figure 1** shows the location of all North American Loran Stations and Control Stations. The sections that follow provide a snapshot of what Loran was "BEFORE" and what Loran will be "AFTER" completion of major LRP efforts.

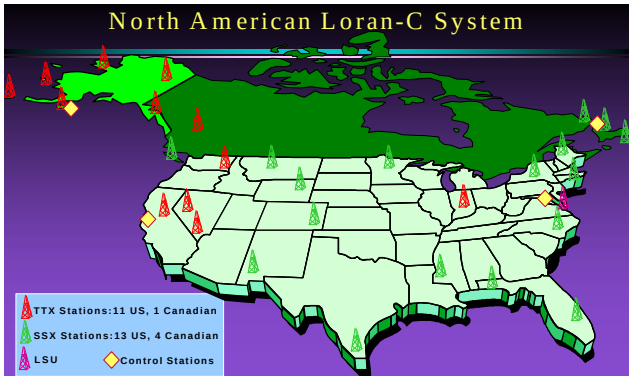

Figure 1: The North American Loran-C System

Control Stations - BEFORE

Prior to 1997, there were six North American Control Stations; four in the U.S. and two in Canada. Control Stations of the past required many personnel (85 in the U.S. alone), formal training, a large facility footprint, and consisted of four labor-intensive, standalone systems. **Figure 2** depicts a typical Control Station prior to 1997.

Figure 2: Control Station - BEFORE

Control Stations - AFTER

There are now four North American Control Stations: Alexandria, VA; Petaluma, CA; Kodiak, AK; and St. Anthony, Newfoundland. Starting in 1997, all Control Station Equipment started being phased out by the Loran Consolidated Control System (LCCS). The LCCS is a computer-based system that provides remote command and control of the Loran-C system. The computer consists of an HP9000/J210 series workstation running the HP-UX 10.10 UNIX operating system. The LCCS application was developed in house with contractors and LSU personnel, "blue-suiters" and civil service alike, working side by side. It is written in C++ and uses the Informix Database Engine for data storage. LSU personnel are solely responsible for the maintenance and upgrades to the LCCS application, the UNIX system administrator functions and the Informix database administrator functions. In December 1998, the last Control Station (Kodiak) switched to the LCCS. The U.S. Coast Guard alone is now saving over $1.46M/year in combined billet and support savings as a result of LCCS deployment. **Figure 3** shows a typical LCCS control suite. One suite controls two Loran-C chains.

The U.S. Coast Guard is now contemplating the further consolidation of U.S. Control Stations. Fewer stations will produce additional personnel, support, and training savings.

Figure 3: Control Station - AFTER

LCCS software is also being modified to include automatic control features, trend analysis reports, and a diverse list of enhancements to improve LCCS functionality. LSU is also working with the U.S. Coast Guard Academy on an upgrade of the current LCCS Time Difference Controller (TDC). A Proportional Integral Derivative (PID) controller and Kalman filter controller will be tested and compared with the current LCCS TDC controller.

Figure 4: PCMS Site - BEFORE

PCMS Sites - BEFORE

Austron 5000 Loran-C receivers and 1960's vintage PDP-8 computers, until recently, were used to monitor and control the broadcast of all Loran-C signals in North America. The 1970s vintage Austron 5000 was large, power-hungry, required use of hand-wound notch filters, a 35' whip antenna with large ground plane, and was difficult to support. The 1960s vintage PDP-8 octal computer with 16K of onboard memory and 0.8MhZ processing speed…need I say more? **Figure 4** shows a typical PCMS equipment suite prior to FY00.

PCMS Sites - AFTER

Since there were no commercially available replacement Loran monitor receivers that met the U.S. Coast Guard requirement to replace the Austron 5000/PDP-8 equipment, a Small Business Innovative Research (SBIR) contract with Locus, Inc. was used to design a new Loran receiver. The Locus LRS-IIID receiver is the outcome of that contract. In FY00 the Locus LRS-IIID receiver replaced the Austron 5000, PDP-8 octal computer, antenna system, and notch filters at all 29 PCMS sites located throughout North America. In addition, new equipment racks were provided and the Elgar 102 Uninterruptible Power Supplies (UPS) were replaced with a Clary DT800R UPS. There are many benefits realized with the new PCMS equipment, including:

- Reliability and availability have increased due to the increase in Mean Time Between Failure (MTBF) with this new technology.
- There has been a significant improvement in performance. The Locus LRS-IIID receiver is a multi-chain receiver that uses a patented linear averaging digital filter, which significantly reduces the cross rate interference (a major source of noise in Loran signals). The Locus LRS-IIID receiver provides additional data information and remote control capabilities, such as, automatic notch filters, remote spectrum scans, and a primary power loss alarm.
- The annual maintenance, support and training costs have decreased. The former PCMS equipment required a local technician be familiar with individual circuit boards and with programming the PDP-8 using dip switches, With the new PCMS equipment, the Lowest repairable Unit (LRU) is the receiver itself. This dramatically simplifies the maintenance and troubleshooting required by the local technician. In addition, the need for lengthy formal PCMS training has been eliminated. **Figure 5** shows the replacement PCMS equipment.

Now that a new multi-chain or "all in view" monitor receiver is installed in the field, the sky's the limit when it comes to controlling the North American Loran System. Currently, primary Loran control in the U.S. and Canada is based on far-field information obtained from two PCMS sites; a Primary "Alpha-1" site and a secondary "Alpha 2" site. With a receiver which can now track up to 11 Loran chains simultaneously installed, the LCCS TDC algorithm could be provided with many more inputs. More inputs equate to better timing stability of the transmitted Loran signals, which equates to better accuracy and repeatability. The U.S. Coast Guard is also investigating Time of Transmission (ToT) control and changing operations to allow master-independent navigation; i.e., not blinking all secondary stations in a Loran chain when the master station is out of tolerance or off-air.

Figure 5: PCMS Site - AFTER

Loran Stations - BEFORE

The 1960-1965 vintage Tube Type Transmitters (TTX) and 1976-1990 vintage Solid State Transmitters (SSX) are currently operating in the North American Loran System. 12 TTX and 17 SSX stations make up the inventory. The 1970-1985 vintage timing and command and control equipment provides the critical timing and control signals to and from the transmitter system. The following Loran Station discussions will be divided into the Operations Room (timing/command & control equipment) and the transmitter system. **Figure 6** shows typical Operations Room, TTX, and SSX equipment.

Figure 6: Operations Room, TTX, and SSX

Loran Stations (Operations Room) - AFTER

Numerous multi-year projects have been started within the last year at LSU to modernize the LORSTA component of the Loran-C system. In FY01, LSU and LORSTA personnel completed the replacement of the HP 5061A cesium beam oscillators with new state-of-the-art HP 5071A oscillators. These new oscillators, considered the "heartbeat" of the Loran system, provide a nine percent improvement to the inherent repeatability of Loran. Typical drift rates are on the order of seven nanoseconds per day versus approximately 200 nanoseconds per day with the older technology. In addition, Time of Transmission Monitor (TTM) equipment has been installed at ten of eleven Master LORSTAs as a tool to better synchronize Loran to Universal Time Coordinated (UTC). **Figure 7** shows newly installed LORSTA oscillators and TTM equipment.

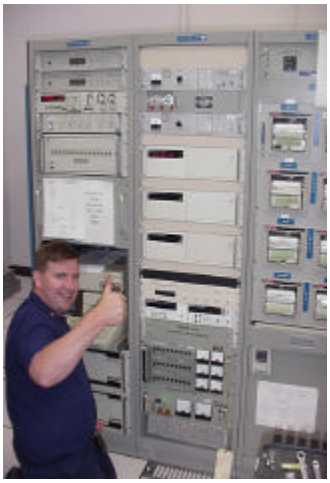

Figure 7: New Cesium Beam Oscillators and TTM Equipment (LORSTA Havre, MT)

LSU completed the installation of the Automatic Blink System (ABS) in FY00. ABS provides a signal integrity indication to Loran-C receivers. Signal integrity involves notifying the user through either "blinking" a secondary LORSTA or taking a master LORSTA "off air". ABS will provide user notification of Time Difference (TD) signal aberrations in less than two seconds. This is especially important to aviation users because of their speed of travel. **Figure 8** shows the ABS unit installed in a LORSTA Timer Rack.

Figure 8: Automatic Blink System

Work is well underway prototyping the Remote Automated Integrated Loran (RAIL) System. RAIL is currently being Field Tested at LORSTAs Jupiter, FL; George, WA; Seneca, NY; Grangeville, LA; and Carolina Beach, NC. The RAIL system is a computer-based system that provides remote (via LCCS) and local command and control of LORSTA equipment. The current RAIL computer consists of a 550 MHz Pentium III processor with various cards installed that provide analog/digital conversions, time interval counter functions, and that expand the number of RS-232 ports to 16. The operating system is Windows NT Version 4.0 and the RAIL software is written in Visual C++ with Roguewave Tools and Lab Windows/CVI Version 5.0.

The RAIL system is being designed to integrate the various equipment installed at a LORSTA and automate as many functions as possible. By default, RAIL becomes the local command and control system for the LORSTA and the remote interface for LCCS.

Here are some of the items being designed into the RAIL system:

- Replace the current Teletype communications system.
- Provide digital charts (replaces up to 14 mechanical, chart recorders).
- Replace the Local Site Operating Set (LSOS) Time Interval Counter.
- Interface with the Automatic Blink System.
- Interface with the Time of Transmission Monitor.
- Interface with the Cesium Beam Oscillators.
- Interface with the new Locus Casualty Control receiver.
- Interface with and then replace the LSOS computer.

Examples of the prototype RAIL Graphical User Interface are shown in **Figures 9** and **10**. The RAIL Home Screen provides a complete picture of the current status of the LORSTA equipment. This screen contains all the data and alarms that must be monitored. A user can navigate to other screens that provide additional details.

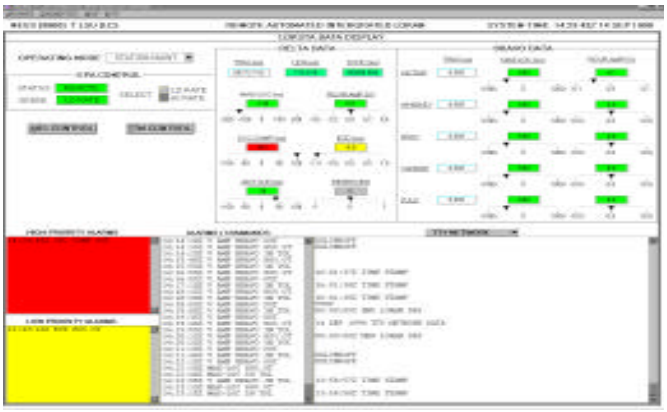

Figure 9: RAIL Home Screen

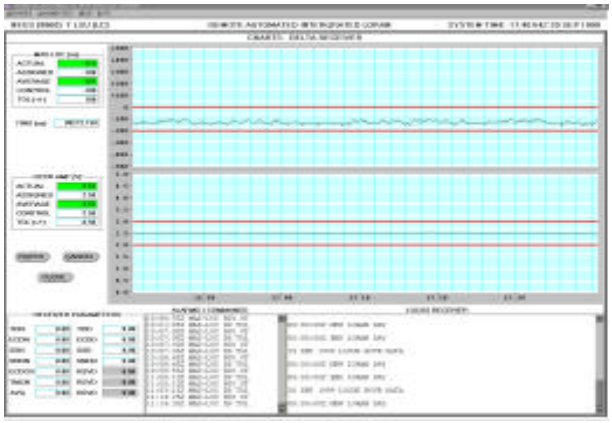

Figure 10: Example of RAIL Charts Screen

Final-form rack-mount RAIL hardware installations at the U.S. SSX Stations are now in the planning stages. In conjunction with the installation of RAIL, the Austron 2000 Casualty Control receivers will be replaced with the same Locus LRS-IIID monitor receivers used at all PCMS sites. Up to 5 Austron 2000 receivers will be replaced with one Locus receiver. **Figure 11** shows the Austron 2000 and Locus receivers.

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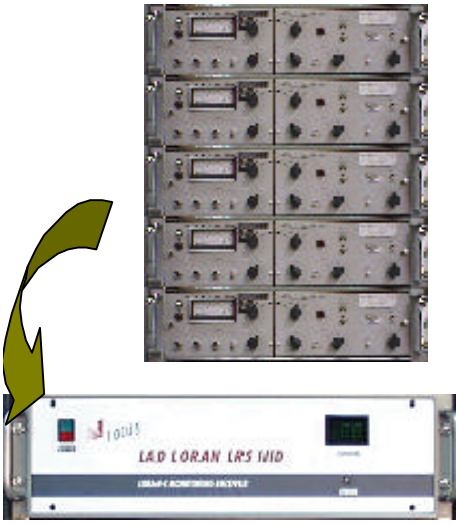

Figure 11: Austron 2000 and Locus LRS-IIID Casualty Control Receivers

Operations Room UPS system installations are also currently underway at all U.S. SSX stations. In conjunction with this installation, existing backup DC power systems, associated hardware and wiring, and conversion of all electrical distribution in accordance with National Electric Code (NEC) standards will be accomplished. The Operations Room UPS systems will not only provide battery backup to all operations room equipment (including the SSX Control Console), but will provide vital line filtering functions. **Figure 12** shows one Operations Room UPS System.

Transmitter UPS systems for selected SSX stations will also be procured and installed in FY01. The Field Test of a prototype transmitter UPS successfully ran a 32 Half Cycle Generator (HCG) SSX transmitter for 34 minutes on battery power! **Figure 13** partially shows the transmitter UPS System.

Figure 12: APC Operations Room UPS System

Figure 13: APC Transmitter UPS System

A solicitation has been prepared to replace the aging suite of Timing and Frequency Equipment (TFE) at all North American LORSTAs. The new suite of equipment will replace the current TFE and will also include updated Automatic Blink System and Time of Transmission Monitor functionality and provide an interface to the RAIL System. Commercial Off The Shelf (COTS) equipment with extended support warranties will be used as much as possible. A copy of the draft TFE performance specification is available at:

http://www.uscg.mil/hq/lsu/webpage/lrp/tfespec.htm

As you can see, the Loran Station Operations Room is in the process of being completely replaced. What will the new Operations Room look like? **Figure 14** shows what the new equipment may look like.

Figure 14: New TFE and RAIL Systems - Operations Room of the Future!

Loran Stations (Transmitter System) - AFTER

Not all of our efforts have been with LORSTA Operations Room modernization. For the past year, LSU and Coast Guard Headquarters procurement specialists have been developing the solicitation for replacement transmitter systems. The primary thrust of this procurement is to replace the AN/FPN-44/45 Tube Type Transmitters at up to 14 locations. State of the art transmitters will enhance Loran Data Channel capability (discussed later in this paper), equipment reliability, and remote control capability, thereby increasing the potential to un-staff all Loran stations. A copy of the transmitter replacement performance specification is available at:

http://www.uscg.mil/hq/lsu/webpage/lrp/xmtrspec.htm

In addition to transmitter replacements, Coast Guard Headquarters, CG Facilities Design & Construction Center Pacific, and LSU have been working together to design the Loran transmitter site of the future. Each site receiving new transmitter systems will require major facility modifications. In FY01 building designs will be completed for the first site to receive a new transmitter system and an effort will be completed to analyze and identify longevity or recapitalization issues for 24 USCG Loran-C transmitting antennae systems. Transmitter facility designs are centered around one major criterion - design the sites for unmanned operations**. Figures 15** and **16** show a comparison between a typical manned LORSTA and what the unmanned Loran transmitting site of the future may look like.

Figure 15: A typical Loran Station

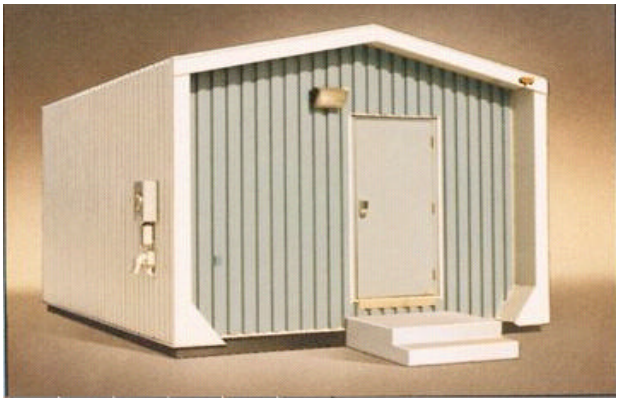

Figure 16: Possible Loran Station of the Future

A great success story in FY00 was the outcome of the Prototype Automated Loran Station (PALS) Field Test conducted at LORSTA Jupiter, FL. PALS developed and tested techniques, procedures, policies, equipment, systems, and infrastructure changes needed to reduce the operating costs of a Loran Station, as well as determining the capability of automating all routine functions.

The primary goal of this project was to identify possible ways to reduce the operational costs while retaining required reliability and availability to the user.

In support of the PALS effort, several upgrades to station electronics were required. The following items were completed prior to the test:

(a) *The Automatic Blink System was installed*.

(b) *LCCS Back-up Communications were installed*.

(c) *The RAIL prototype was installed*.

(d) *New HP 5071A cesium beam oscillators were in stalled.*

(e) *A prototype Operations Room UPS system was in stalled*.

(f) *A prototype transmitter UPS system was installed*.

LORSTA Jupiter began the PALS field test on April 2, 2000. To date, the PALS field test has been a complete success. It has shown that a Loran Station with a solid state transmitter can be operated as an unmanned transmitter site, while continuing to meet the required 99.9% availability standard. The field test was originally scheduled for completion on October 31, 2000, but due to the overwhelming success, LORSTA Jupiter will continue in its present configuration with future plans to fully implement the automation in FY01. PALS Phase II expands testing of the PALS concept at additional Loran Stations in the Southeast U.S. (SEUS) Loran Chain: Loran Stations Grangeville, LA and Carolina Beach, NC. These stations will first need to receive Operations Room and Transmitter UPS systems and the RAIL System prior to the initiation of the PALS concept. Installation of this equipment into the LSU Master Configuration Baseline Equipment (MCBE) is also included with this phase of the project.

ENHANCED LORAN-C CAPABILITIES

The FAA has been directed to assess the continued development of Loran-C. The LSU, in cooperation with Stanford University, the Coast Guard Academy, and private FAA contractors is developing an enhanced Loran Communications Capability for GPS integrity and potentially for GPS correction data that meets the FAA's Wide Area Augmentation System (WAAS) requirements. Stanford University and FAA contractors are researching and developing several different modulation schemes: Pulse Position Modulation (PPM), Intrapulse Frequency Modulation (IFM), and Supernumerary (Interpulse) Modulation (SIM), with an emphasis on the IFM technique. In conjunction with contractors and Stanford University, LSU will cooperate in the evaluation of viable data formats and technology to permit the modulation and demodulation of data messages transmitted via modulation of Loran signal pulse's). Analysis of the effects of the various modulation schemes on cycle compensation, Envelope-to-Cycle Difference (ECD), and other parameters will be conducted. Also, the effects on legacy receivers will be analyzed. Live flight tests in Alaska are scheduled in August 2001. In addition, the FAA and LSU will provide funds to the Coast Guard Academy to support continued development of a digital multi-chain navigation receiver. **Figure 17** depicts how Loran-C may be integrated into the FAA's Wide Area Augmentation System (WAAS).

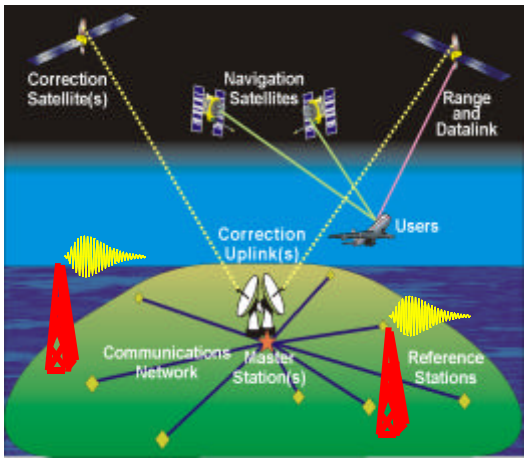

Figure 17: Loran-C and WAAS

THE LORAN-C SYSTEM OF THE FUTURE…THE SKY'S THE LIMIT!

As you have just read, the North American Loran-C System is currently undergoing a complete face-lift. The Loran Recapitalization Project is paving the way to improve the availability, continuity, integrity, and accuracy of the world's premier radionavigation system.

Stayed tuned for future updates. Contact LCDR Al Arsenault at (609) 523-7349 or via email at aarsenault@lsu.uscg.mil for additional information. Individual project status can be accessed via the LSU Web Page at *http://www.uscg.mil/hq/lsu/webpage/projects.htm.*

-Note– The views expressed herein are those of the author and are not to be construed as official or reflecting the views of the Commandant, U.S. Coast Guard, or U.S. Department of Transportation.

United States Coast Guard Navigation Center

The United States Coast Guard Navigation Center (NAVCEN) provides quality navigation services that promote safe transportation and support the commerce of the United States. Under the authority of 14 U.S. C. 81 and in support of the International Convention for the Safety of Life at Sea, NAVCEN is responsible for operating radionavigation systems and disseminating navigation information. NAVCEN also plays a central role in facilitating the civil use of the Global Positioning System (GPS), in support of Department of Transportation goals.

NAVCEN operates and manages Coast Guard radionavigation systems from two sites-Alexandria, Virginia and Petaluma, California. With 29 transmitting and 3 control stations, the Loran-C system provides service in the continental United States and Alaska. Linked with Canadian and Russian transmitting stations, Loran-C serves marine, air, and land navigation, as well as precise timing and other scientific applications. The Maritime Differential Global Positioning System (DGPS) network of 70 remote broadcast sites serves United States coastal areas, including the Great Lakes, Puerto Rico, most of Alaska, Hawaii and the Western River system, and provides the accuracy and performance to support harbor entrance and approach navigation. There are 4 more remote broadcast sites in the final stages of construction upcoming by summer 2001. The Nationwide DGPS (NDGPS) service expands coverage of the Maritime DGPS service to the entire continental United States and greater portions of Alaska, and provides the accuracy and performance to support numerous land applications.

Through operation of the Navigation Information Service (NIS), NAVCEN provides the public with information on navigation systems and other waterways safety topics. This 24-hour service uses the latest computer and Internet technologies to gather, process, and disseminate timely radionavigation system status, marine advisories, and other maritime information. NAVCEN also coordinates and manages the Civil GPS Service Interface Committee (CGSIC) as part of the Department of Transportation's initiative to integrate GPS use into civil sector applications. CGSIC is recognized world-wide as the forum for effective interaction between civil GPS users and United States government service providers.

As a center of navigation excellence, NAVCEN is proud to continue the Coast Guard's long tradition of supporting waterway safety and maritime commerce. Through the use of new technologies such as DGPS and NDGPS, NAVCEN will serve our nation's transportation needs well into the 21st century.

Contacting the Navigation Information Service (NIS)

Internet:
http://www.navcen.uscg.gov

E-Mail:
nisws@smtp.navcen.uscg.mil

GPS Status Recording:
Telephone: (703) 313-5907

Fax On Demand (FOD):
(703) 313-5920

WWV/WWVH Radio Broadcast:
WWV broadcasts by telephone or radio at 14-15 minutes past the hour and WWVH at 43-44 minutes past the hour.
Radio frequencies: 2.5, 5, 10, 15, & 20 MHz.
Telephone: (303) 499-7111

Write or Call:
Commanding Officer (NIS)
U.S. Coast Guard Navigation Center
7323 Telegraph Road
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Coast Guard SDL No. 137

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A	1	1	1		1	1	1	1	1	1		1	1	1	1	1	1		1		2					
B		10	10	3	10	2	2	5	5	2	5	3	3	3	3	2	1	5	3	1	1		2	2	5	1
C	5	3	1	5	2	3	3		1	1	3	2	1	5	1		1	1	1	1	1	2	2	1	1	1
D	1	1	1	2	1	1		1	1	1	1	1	1		1	1			1	2	1	1	1			1
E	1		1				1	1		1	1	1	1	1	1				1	1		1	1			
F																	1	1	1							
G	1	1	1	1	1																					
H																										

NON-STANDARD DISTRIBUTION: CG-31 (1), CG-56 (1), CG-64 (1)